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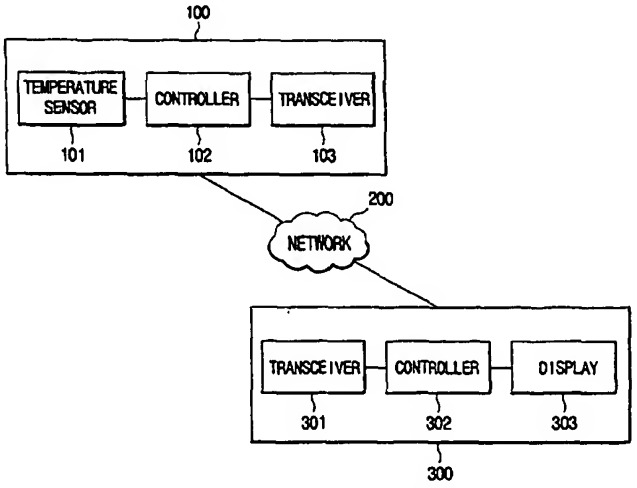
(54) Title: DEVICE FOR DETECTING WAFER POSITIONING FAILURE ON SEMICONDUCTOR PROCESSING DEVICE AND METHOD THEREOF



(57) Abstract: The present invention relates to a device for real-time monitoring semiconductor processing equipment and method thereof. According to the present invention, a device for detecting wafer-positioning failure in semiconductor processing equipment having at least one chamber, said device comprising: means for receiving the heater's temperature from the semiconductor processing equipment, means for extracting the heater's lowest temperature from a plurality of the heater's temperatures, which are received for a specific time that is predetermined according to characteristics of the semiconductor processing equipment, means for determining whether or not the wafer-positioning failure occurs by comparing the heater's lowest temperature and a predetermined thereshold value, and means for managing the occurred wafer-positioning failure that has occurred according to a predetermined instruction, is provided.

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DEVICE FOR DETECTING WAFER POSITIONING FAILURE ON SEMICONDUCTOR PROCESSING DEVICE AND METHOD THEREOF

TECHNICAL FIELD

The present invention relates to a device for real-time monitoring semiconductor processing equipment and method thereof, and more particularly, a device for detecting and adjusting positioning failure of a processing object(i.e., wafer) that has occurred in the semiconductor processing equipment having a heating device and transferring device and method thereof.

BACKGROUND ART

Contrary to retrenchment in the size of silicon chip, the size of wafer and the degree of integration have increased more and more. Accordingly, automation of the manufacturing process is required in order to maintain the high level of cleanliness and increase reliability of the product.

As a result of automation of the semiconductor manufacturing process, however, a new problem resulted that the semiconductor manufacturing process had to continue without detecting a failure that occurred in the process. Accordingly, semiconductor manufacturers and processing equipment manufacturers need a tool that can ascertain whether or not the semiconductor manufacturing procedure is performed in the

processing equipment under normal condition.

FIG 1A and FIG 1B show the semiconductor processing equipment using a hot-plate type oven; FIG 2A and FIG 2B are illustrative views of inserting a wafer into the semiconductor processing equipment; FIG 3A and FIG 3B show the state that a wafer is normally located the oven of the chamber; and FIG 4A and FIG 4B show the state that wafer is abnormally located on the oven of the chamber.

Referring to FIG 1A to FIG 2B, a gap spacer 11 is located on the bottom side of the stopper 10 in order to keep a proper space between the wafer 20 and hot plate 13.

Track equipment or etching equipment using the hot plate 13 applies heat to the wafer 20 by leaving a proper space between the wafer 20 and hot plate 13. The reason to leave a proper space between the wafer 20 and hot plate 13 is to prevent the back of the wafer from being contaminated by the oven.

Referring to FIG 3A and 3B, there is no gap between the oven and wafer 20 because the wafer 20 is normally located on the oven. The wafer that is located on the oven is properly spaced to the hot plate 13 by a gap spacer 11 that is located below the stopper 10.

The oven in the semiconductor processing equipment is set to a characteristic temperature, and applies heat to a wafer if the wafer is located on the oven. Although the characteristic temperature of the oven depends on the characteristics of equipment and the manufacturer, the temperature of the oven is generally higher than that of the

wafer. Accordingly, only when the wafer is located on the oven without a gap between the oven and the wafer 20 as shown in FIG 3A, the heat can be applied to the wafer uniformly.

Referring to FIG 4A and FIG 4B, because the wafer is abnormally located on the oven, a gap exists between the oven and the wafer 20, and as a result positioning failure occurs.

The gap between the oven and the wafer 20 takes place because the wafer 20 is located on the stopper 10 with an inclination. The wafer 20 being located on the stopper 10 with an inclination is caused as follows: (1) as shown in FIG 4A, the transferring device does not correctly transfer the wafer, or (2) the wafer 20 itself is bent. Because the object of the present invention does not coincide with a solution to the cause, no further causes are described. Referring to FIG 9A and FIG 9B, it is known that wafer-positioning failure occurs repeatedly during the process of positioning wafers, which are included in the same lot, on the oven, in the semiconductor processing equipment where wafer-positioning failure once occurs.

Accordingly, as aforementioned, if there is a gap between the oven and the wafer 20, the heat radiated from the oven cannot be applied properly to the wafer, and as a result, the wafer cannot be heated normally.

As aforementioned indicated, in the process of positioning a wafer on the oven from the automated semiconductor processes, the situation that the process will

continue even though that wafer is abnormally located on the oven frequently occurs. Accordingly, if the process resulting in wafer-positioning failure continues, a tremendous reduction of the yield will occur.

The fact that the yield will be reduced by the wafer-positioning failure is well-known to those who are skilled in the art. However, the device or the method for real-time detecting wafer-positioning failure has never been developed.

DISCLOSURE OF THE INVENTION

It is a primary object of the present invention to provide a device for detecting wafer-positioning failure on semiconductor processing equipment and method thereof by using a variation in the heater's temperature when a wafer is inserted into the oven.

It is another object of the present invention to provide a device for detecting wafer-positioning failure on semiconductor processing equipment and method thereof that can produce a control signal for adjusting and preventing wafer-positioning failure when wafer-positioning failure occurs in the semiconductor processing equipment by conveying a wafer mechanically.

To achieve aforementioned objectives, according to the one aspect of the present invention, a device for detecting wafer-positioning failure in semiconductor processing equipment having at least one chamber, wherein the wafer is located on a heater of the chamber, said device comprising: means for receiving the heater's

temperature from the semiconductor processing equipment, means for extracting the heater's lowest temperature from a plurality of heater's temperature, which are received for a specific time that is predetermined according to characteristics of the semiconductor processing equipment, means for determining whether or not the wafer-positioning failure by comparing the heater's lowest temperature and a predetermined threshold value and means for managing the wafer-positioning failure that has occurred according to a predetermined instruction, is provided.

Also, the device further comprises means for inputting a threshold value, wherein the threshold value is extracted from a plurality of heater's temperatures that are measured while the wafer-positioning failure does not occur. And the threshold value is an average of the heater's lowest temperatures that are measured while the wafer-positioning failure does not occur.

The heater's temperature is transmitted by at least one selected from the group consisting of SECS[SEMI(SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL) EQUIPMENT COMMUNICATION STANDARD] protocol, GEM protocol, and HSMS protocol via serial cable that is connected between the semiconductor processing equipment and said device.

The means for receiving heater's temperature from the semiconductor processing equipment comprises: means for receiving parameter data, wherein parameter data are related to the operating state and the process condition of the

semiconductor processing equipment and means for extracting the heater's temperature from the received parameter data.

The parameter data are transmitted by at least one selected from the group consisting of SECS protocol, GEM protocol, and HSMS protocol via serial cable that is connected between the semiconductor processing equipment and said device. Also, the parameter data are transmitted via at least one selected from the group consisting of either wired/wireless LAN or wired/wireless Internet whereby the semiconductor processing equipment and said device are coupled to the group.

The means for determining whether or not the wafer-positioning failure occurs by comparing the heater's lowest temperature and a predetermined threshold value comprises: a flag indicating true and false for storing the occurrence of the wafer-positioning failure, means for comparing the heater's lowest temperature with the threshold value in order to change an initialized value of said flag into true when the heater's lowest temperature is smaller than the threshold value and means for detecting the value of said flag in order to determine wafer-positioning failure.

Also, the device further comprises means for comparing each of the heater's temperatures, which are received for a specific time that is predetermined according to characteristics of the semiconductor processing equipment, in order to determine whether or not wafer has been inserted.

The predetermined instruction is at least one selected from the group consisting

of an instruction for outputting wafer-positioning failure signal, an instruction for suspending the process of the semiconductor processing equipment when wafer-positioning failure occurs, an instruction for adjusting wafer-positioning failure, and an instruction for adjusting the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs.

The means for managing the wafer-positioning failure that has occurred according to predetermined instruction comprises: means for producing an adjusting control signal to adjust the position of wafer or the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs and means for outputting a positioning failure signal.

The means for outputting a positioning failure signal can be at least one selected from the group consisting of means for displaying, means for producing sound, and means for transmitting SMS or voice message, wherein said means for displaying comprises CRT and TFT and said means for producing sound comprises a buzzer.

According to another aspect of the present invention, a method for detecting wafer-positioning failure in semiconductor processing equipment having at least one chamber, wherein the wafer is located on a heater of the chamber, said method comprising the steps of: the step of receiving the heater's temperature from the semiconductor processing equipment, the step of extracting the heater's lowest temperature from a plurality of the heater's temperatures, which are received for a

specific time that is predetermined according to characteristics of the semiconductor processing equipment, the step of determining whether or not the wafer-positioning failure occurs by comparing the heater's lowest temperature and a predetermined threshold value and the step of managing the wafer-positioning failure that has occurred according to predetermined instruction.

Also, the method further comprises the step of inputting a threshold value, wherein the threshold value is extracted from a plurality of the heater's temperatures that are measured while the wafer-positioning failure does not occur.

The threshold value is an average of the heater's lowest temperatures that are measured while the wafer-positioning failure does not occur.

The heater's temperature is transmitted by at least one selected from the group consisting of SECS[SEMI(SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL) EQUIPMENT COMMUNICATION STANDARD] protocol, GEM protocol, and HSMS protocol.

The step of receiving the heater's temperature from the semiconductor processing equipment comprises the steps of: the step of receiving parameter data, wherein parameter data are related to the operating state and the process condition of the semiconductor processing equipment and the step of extracting the heater's temperature from the received parameter data.

The parameter data are transmitted by at least one selected from the group

consisting of SECS protocol, GEM protocol, and HSMS protocol.

The step of determining whether or not the wafer-positioning failure occurs by comparing the heater's lowest temperature and a predetermined threshold value comprises: the step of storing false in a flag for indicating the occurrence of the wafer-positioning failure, the step of comparing the heater's lowest temperature with the threshold value in order to change initialized value of said flag into true when the heater's lowest temperature is smaller than the threshold value and the step of detecting the value of the flag in order to determine wafer-positioning failure.

The method further comprises the step of comparing each of heater's temperatures, which are received for a specific time that is predetermined according to characteristics of the semiconductor processing equipment, in order to determine whether or not wafer has been inserted.

The predetermined instruction is at least one selected from the group consisting of an instruction for outputting wafer-positioning failure signal, an instruction for suspending the process of the semiconductor processing equipment when wafer-positioning failure occurs, an instruction for adjusting wafer-positioning failure, and an instruction for adjusting the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs.

The of managing the wafer-positioning failure that has occurred according to predetermined instruction comprises: the step of producing an adjusting control signal

to adjust the position of wafer or the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs and the step of outputting a positioning failure signal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1A is a topside view of the semiconductor processing equipment using hot-plate type oven;

FIG 1B is a cross-sectional view of the semiconductor processing equipment in FIG 1a;

FIG 2A shows the state of inserting a wafer into the semiconductor processing equipment using hot-plate type oven;

FIG 2B is a cross-sectional view of the semiconductor processing equipment in FIG 2a;

FIG 3A shows the state that a wafer is normally located on the oven of the chamber;

FIG 3B is a cross-sectional view of the semiconductor processing equipment in FIG 3a;

FIG 4A shows the state that a wafer is abnormally located on the oven of the chamber;

FIG 4B a cross-sectional view of the semiconductor processing equipment in

FIG 4a;

FIG 5 is a pictorial representation of a system for detecting wafer-positioning failure that can be utilized to implement the device and method of the present invention;

FIG 6 is a flowchart of the procedure for determining whether or not the wafer-positioning failure has occurred in accordance with the preferred embodiment of the present invention;

FIG 7A shows the variation of heater's temperature when there is wafer-positioning failure;

FIG 7B shows the variation of heater's temperature when there is no wafer-positioning failure;

FIG 8A and FIG 8B show the heater's temperature when there is no gap between the heater of chamber and the wafer;

FIG 9A and FIG 9B show the heater's temperature when there is a gap between the heater of chamber and the wafer.

<Reference numbers assigned to the major parts of the drawings>

10 : stopper

11 : gap spacer

12 : pin

13 : hot plate

20 : wafer

100 : semiconductor processing equipment

101 : temperature sensor

102 : controller

103 : transceiver

200 : network

300 : device for detecting wafer-positioning failure

301 : transceiver

302 : controller

303 : display

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the preferred embodiment of the present invention will be described with accompanying drawings.

FIG 5 is a pictorial representation of a system for detecting wafer-positioning failure which can be utilized to implement the device and method of the present invention.

Before describing FIG 5, SECS[SEMI(SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL) EQUIPMENT COMMUNICATION STANDARD] protocol, GEM protocol and HSMS protocol, are communication

protocols between semiconductor processing equipment and hosts.

SECS protocol is a standard communication protocol that is utilized by semiconductor processing equipment to receive operating instructions for manufacturing process or to transmit parameter data, such as operation condition or process condition, to the host. SECS protocol includes SECS-I and SECS-II.

GEM protocol is a communication protocol, which is an improvement of SECS protocol, between semiconductor processing equipments and hosts, and is utilized in serial communication like SECS protocol. Generally, brand-new semiconductor processing equipment supports SECS protocol and GEM protocol at the same time.

HSMS protocol is a communication protocol between semiconductor processing equipment and hosts the same as the above-described SECS protocol and GEM protocol. Compared with SECS protocol and GEM protocol that are utilized in serial communication, HSMS protocol is utilized in wired/wireless LAN or Internet using TCP/IP protocol.

Referring to FIG 5, a system for detecting wafer-positioning failure can comprise semiconductor processing equipment 100, network 200, and device for detecting wafer-positioning failure 300.

Semiconductor processing equipment 100 comprises temperature sensor 101, controller 102, and a transceiver 103. The semiconductor processing equipment 100 measures the temperature of oven or heater, converts the measured temperature into

SECS protocol, and then transmits the converted temperature to the device for detecting wafer-positioning failure 300 via the network 200.

The semiconductor processing equipment 100 comprises a heating device (hereinafter 'heater'), which comprises an oven or heater and a transferring device. In this description, for the sake of describing wafer processing equipment such as photo, track, or etching equipment, they are referred to as semiconductor processing equipment. However, the present invention is not limited to these types of various wafer processing equipment. As a matter of course the present invention can be utilized in all processing equipment comprising LCD processing equipment or a PDP processing equipment having heater and transferring device.

The temperature sensor 101 measures heater's temperature in the chamber and generates temperature data. The temperature data generated by the temperature sensor 101 are transmitted to the controller 102. Generally, the heater in the chamber maintains specific temperature by way of PID controller, and any variation of the heater's temperature is detected by temperature sensor 101.

Especially, the temperature that is detected by the temperature sensor 101 is not the temperature of the wafer, but the temperature of the heater. Accordingly, when the wafer is inserted into the semiconductor processing device, the heater's temperature is minutely changed due to the relatively-low temperature of the wafer. So it is preferable that the temperature sensor 101 has high sensing ability.

The controller 102 controls the semiconductor processing equipment by the use of an instruction for adjusting received from the device for detecting wafer-positioning failure 300, and parameter data, such as the operating state and the process condition that are transmitted from a plurality of sensors including the temperature sensor 101. In the present invention, the controller 102 can be controlled by the instruction for adjusting that is generated by the device for detecting wafer-positioning failure 300. The controller 102 can control the heater's temperature by the use of temperature data from the temperature sensor 101.

The transceiver 103 converts the parameter data including temperature data into communication data by utilizing any one of SECS protocol, GEM protocol, and HSMS protocol, and then transmits the converted communication data to the device for detecting wafer-positioning failure 300 via network 200. Also, the transceiver 103 converts only temperature data into communication data by utilizing any one of serial communication protocol, SECS protocol, GEM protocol and HSMS protocol, and then transmits the converted communication data to the device for detecting wafer-positioning failure 300 via network 200. And, the transceiver 103 can transmit the instruction for adjusting from the device for detecting wafer-positioning failure 300 to the controller 102.

The transceiver 103 comprises at least one RS-232c serial port and can perform asynchronous bi-directional communication with the device for detecting wafer-

positioning failure 300. Also, the transceiver 103 can further comprise at least one LAN port for transmitting and receiving parameter data and the instruction for adjusting by any one of TCP/IP, Ethernet or token ring protocol.

Regarding semiconductor processing equipment that does not have either the temperature sensor or the transceiver, the temperature sensor or the transceiver can be installed to the semiconductor processing equipment. Accordingly, only temperature data can be provided from the semiconductor processing equipment.

The network 200 is a communication network that can be utilized for transmitting data between the semiconductor processing equipment 100 and the device for detecting wafer-positioning failure 300. The network can be any one of serial cable, wired/wireless LAN, and wired/wireless Internet.

Regarding serial cable, the semiconductor processing equipment 100 and the device for detecting wafer-positioning failure 300 are directly connected, and as a result, 1-to-1 communication is available. In this situation, the heater's temperature can be transmitted by general-purpose serial communication protocol.

The device for detecting wafer-positioning failure 300 comprises a transceiver 301, controller 302, and display 303.

The transceiver 301 receives communication data from the semiconductor processing equipment 100, converts communication data into parameter data, and transmits parameter data to the controller 302. Also, the transceiver 301 can transmit the

instruction for adjusting to the semiconductor processing equipment. The transceiver 301 can extract temperature data from parameter data, and then transmit the temperature data to the controller 302.

The transceiver 301 comprises RS-232C serial port and can perform asynchronous bi-directional communication with the semiconductor processing equipment 100. Also, the transceiver 301 can further comprise at least one LAN port for transmitting and receiving parameter data and the instruction for adjusting by any one of TCP/IP, Ethernet or token ring protocol.

The controller 302 determines whether or not wafer-positioning failure occurs by using parameter data from the semiconductor processing equipment 100; and according to a determination if wafer-positioning failure occurs, the controller 302 transmits a positioning failure signal to the display 303.

The controller 302 receives temperature data from the transceiver 301 and then determines whether or not wafer-positioning failure occurs by comparing the temperature data with a predetermined threshold value. The threshold value is selected from specific periods of testing each semiconductor processing equipment and is an average of the heater's lowest temperatures that are measured while the wafer-positioning failure does not occur.

When wafer-positioning failure occurs, the controller 302 generates the instruction for adjusting to control the semiconductor processing equipment 100. As

described, the wafer-positioning failure occurs when the transferring device does not move the wafer precisely on the heater of the chamber. By way of preparation for the occurrence of wafer-positioning failure, a supervisor can select any one of the following instructions in advance: (1) instruction for suspending the semiconductor processing equipment and awaiting manual instruction from the supervisor, (2) instruction for adjusting the positioning-failure resulting wafer, and (3) instruction for adjusting the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs. Referring to FIG 9A and FIG 9B, wafer-positioning failure continuously occurs in the semiconductor processing equipment when wafer-positioning failure occurs once.

The instruction for adjusting can be (1) inputted manually by the supervisor, or (2) generated automatically by an instruction that was inputted in advance. Regarding option of (1), until the instruction for adjusting is inputted by the supervisor, an instruction for suspending the semiconductor processing equipment can be generated before the instruction for adjusting. Regarding option of (2), the heater's temperatures resulting from the gap between the heater and the wafer, whereby the heater's temperatures are stored in a database, can be utilized. For example, when the gaps 0, 0.01mm and 0.02mm correspond respectively to threshold values 90 ℃, 90.3 ℃ and 90.7 ℃, it is possible to control the position where the wafer is located according to the measured temperature.

The variation of the heater's temperature due to the gap between the heater of chamber and the wafer will be described by referring to FIG 8A to FIG 9B.

FIG 8A and FIG 8B show the heater's temperature when there is no gap between the heater of the chamber and the wafer, and FIG 9A and FIG 9B show the heater's temperature when there is a gap between the heater of the chamber and the wafer. FIG 8a and FIG 9a show the overlapping variation of heater's temperature measured over 10 times, and FIG 8b and FIG 9b show the separated variation of heater's temperature.

Referring to FIG 8a to FIG 9b, the variation of heater's temperature when there is no gap is larger than when there is a gap. If a wafer that is relatively colder than the heater contacts the hot plate with an inclination, no heat of the heater is applied to the wafer. As a result, the variation of temperature becomes smaller due to the interaction between the heater and the wafer. Accordingly, if the wafer contacts the heater without a gap, a great variation in the heater's temperature occurs due to the vigorous heat exchange between the heater and the wafer.

Even though FIG 8a to FIG 9b are calculated data for describing the variation of the heater according to the gap, people skilled in the art can easily measure the variation of the temperature according to the size of gap, calculate threshold value according to the measured variation, and generate the instruction for adjusting. Therefore, detailed description of that will be omitted.

Referring to FIG 5 again, the display 303 shows the occurrence of wafer-positioning failure to the supervisor. The display 303 is any one of an image display such as CRT monitor or TFT monitor, sound producing device such as buzzer, and mobile terminal that can transmit SMS or voice message.

If the display 303 is an image display, the display shows temperature data from the semiconductor processing equipment 100, the occurrence of the wafer-positioning failure, and an input screen for inputting the instruction for adjusting from the supervisor.

If the display 303 is a sound producing device, the display can output a warning sound in order to notify the occurrence of the wafer-positioning failure to the supervisor.

If the display 303 is a mobile terminal, the display can transmit not only temperature data, but also SMS or voice message that notifies the occurrence of the wafer-positioning failure to the supervisor's mobile terminal.

FIG 6 is a flowchart of the procedure for determining whether or not the wafer-positioning failure occurs in accordance with the preferred embodiment of the present invention. FIG 7a to FIG 9b will be referred to in order to describe FIG 6.

Referring to FIG 6, at step 400, the threshold value of the semiconductor processing equipment is selected. The semiconductor processing equipment comprises all equipment having a chamber that apply heat to the wafer by utilizing hot-plate type heater. More particularly, semiconductor processing equipment comprises photo

equipment, track equipment, etching equipment, and so on.

Because threshold values of each semiconductor processing equipment are different, by performing the test many times, an average of the heater's lowest temperatures that are measured when the wafer is located on the proper position is selected as the threshold value. It is preferable to select the threshold value by performing tests on a plurality of wafers having same lot.

FIG 8a and FIG 8b are referred to in order to describe the procedure for selecting the threshold value of the semiconductor processing equipment.

Referring to FIG 8a and FIG 8b, if there is no wafer-positioning failure, the heater's ten lowest temperatures are measured from ten wafers, and the average of these lowest temperatures of the heater is selected as a threshold value.

Referring to FIG 6 again, if one device for detecting wafer-positioning failure monitors a plurality of semiconductor processing equipment, threshold values of each equipment are stored. And whenever temperature data is transmitted from any one of the equipment, the device for detecting wafer-positioning failure is initialized by threshold value corresponding to the equipment.

At step 410, the semiconductor processing equipment measures heater's temperatures at arbitrary time $t - 3\Delta t$, $t - 2\Delta t$, $t - \Delta t$, t, $t + \Delta t$, $t + 2\Delta t$, $t + 3\Delta t$, generates temperature data, and transmits to the device for detecting wafer-positioning failure. At the step 410, the semiconductor processing equipment can measure and

transmit only heater's temperature at every pre-fixed Δt. Also, the semiconductor processing equipment can measure and transmit parameter data including not only the heater's temperature but also the operating state and the process condition at every Δt. When receiving parameter data, the step of extracting temperature data is further performed.

It is also possible for the semiconductor processing equipment to transmit temperature data only when there is a variation in the heater's temperature. Because PID controller controls the heater's temperature to maintain a uniform temperature according to the characteristics of the equipment, the heater's temperature is maintained at a uniform temperature if there is no situation such as wafer insertion.

The heater's measured temperature is transmitted to the device for detecting wafer-positioning failure via serial cable by general-purpose serial communication protocol. Also, the heater's measured temperature is transmitted to the device for detecting wafer-positioning failure via wired/wireless LAN or wired/wireless Internet by SECS protocol, GEM protocol or HSMS protocol.

At step 420, the device for detecting wafer-positioning failure stores the heater's temperature at t in memory, and compares the heater's temperature at t with heater's temperatures at t - 3Δt, t - 2Δt, t – Δt to determined whether or not the wafer is inserted. That is, by comparing heater's temperatures at t - 3Δt, t - 2Δt, t – Δt with the heater's temperature at t, the device for detecting wafer-positioning failure can detect

the insertion of wafer and start the procedure for determining whether or not the wafer-positioning failure occurs.

At step 430, the device for detecting wafer-positioning failure reads the heater's temperature at t, and at step 440, sets the state of positioning the failure flag to 'FALSE'.

At step 450, since the procedure is started, the heater's lowest temperature that is measured at pre-fixed transition interval of the heater's temperature is compared with the threshold value that is selected at step 400. The transition interval is the time to be taken to recover the characteristic temperature of the equipment when there is a variation in the heater's temperature due to the insertion of the wafer. According to the comparison, if the heater's lowest temperature is lower than the threshold value, then the state of positioning the failure flag is set to 'TRUE'.

FIG 7A and FIG 7B are referred in order to describe the procedure for setting the state of positioning the failure flag by comparing the heater's lowest temperature with the threshold value.

FIG 7A shows the variation of heater's temperature when there is wafer-positioning failure, and FIG 7B shows the variation of heater's temperature when there is no wafer-positioning failure.

Referring to FIG 7A and FIG 7B, the characteristic temperature and the threshold value of the semiconductor processing equipment are 150 ℃ and 149.2 ℃

respectively.

As shown in FIG 7A, since the heater's lowest temperature is 149.3 ℃ and higher than the threshold value 149.2 ℃, the wafer-positioning failure occurs. Accordingly, the state of positioning the failure flag is not changed. To the contrary, as shown in FIG 7B, since the heater's lowest temperature is 149.1 ℃ and lower than the threshold value, the wafer-positioning failure does not occur. Accordingly, the state of positioning the failure flag is set to 'TRUE'.

Referring to FIG 6 again, at step 460, as a result of comparing heater's temperatures at $t - 3\Delta t$, $t - 2\Delta t$, $t - \Delta t$ with the heater's temperature at t, if the heater's temperature is converging to the characteristic temperature of the equipment, then the procedure terminates according to the determination that no more wafer insertion exists.

At step 470, by detecting the positioning failure flag, if the flag is set to 'FALSE', then the warning of wafer-positioning failure is outputted through the display.

Although it is not shown in FIG 6, the step of producing an adjusting control signal to adjust the position of wafer or the transferring device of the semiconductor processing equipment can be further performed after the warning of wafer-positioning failure is outputted at step 470.

If the adjusting control signal is generated, then according to the predetermined instruction of the supervisor, the device for detecting wafer-positioning failure performs to suspend the semiconductor processing equipment when wafer-positioning failure

occurs and wait until the supervisor inputs an instruction manually, or resolve the wafer-positioning failure automatically.

When resolving the wafer-positioning failure automatically, it is possible to prevent that same wafer-positioning failure to occur repeatedly by adjusting the transferring device in the semiconductor processing equipment when wafer-positioning failure occurs.

While the preferred embodiment of the present invention has been described herein, it is not intended to limit the scope of the present invention to the appended claims. Therefore, in the aforementioned technical field, additional variations and modifications in that embodiment may be obvious to those who are skilled in the art once they learn of the basic inventive concept.

INDUSTRIAL APPLICABILITY

According to the present invention, a device for detecting wafer-positioning failure on semiconductor processing equipment and method thereof by using the variation of the heater's temperature when a wafer is inserted into an oven are provided.

Also, according to the present invention, a device for detecting wafer-positioning failure on semiconductor processing equipment and method thereof that can produce a control signal for adjusting and preventing wafer-positioning failure when

wafer-positioning failure occurs in the semiconductor processing equipment conveying wafer mechanically are provided.

CLAIMS

1. A device for detecting wafer-positioning failure in semiconductor processing equipment having at least one chamber, wherein the wafer is located on a heater of the chamber, said device comprising:

means for receiving the heater's temperature from the semiconductor processing equipment;

means for extracting the heater's lowest temperature from a plurality of heater's temperature, which are received for a specific time that is predetermined according to characteristics of the semiconductor processing equipment;

means for determining whether or not the wafer-positioning failure by comparing the heater's lowest temperature and a predetermined threshold value; and

means for managing the wafer-positioning failure that has occurred according to a predetermined instruction.

2. The device as stated in claim 1 further comprising means for inputting a threshold value, wherein the threshold value is extracted from a plurality of heater's temperatures that are measured while the wafer-positioning failure does not occur.

3. The device as stated in claim 1 or claim 2, wherein the threshold value is an average of the heater's lowest temperatures that are measured while the wafer-

positioning failure does not occur.

4. The device as stated in claim 1, wherein the heater's temperature is transmitted by at least one selected from the group consisting of SECS[SEMI(SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL) EQUIPMENT COMMUNICATION STANDARD] protocol, GEM protocol, and HSMS protocol.

5. The device as stated in claim 1 or claim 4, wherein the heater's temperature is transmitted via serial cable that is connected between the semiconductor processing equipment and said device.

6. The device as stated in claim 1, wherein said means for receiving heater's temperature from the semiconductor processing equipment comprises:

means for receiving parameter data, wherein parameter data are related to the operating state and the process condition of the semiconductor processing equipment; and

means for extracting the heater's temperature from the received parameter data.

7. The device as stated in claim 6, wherein the parameter data are transmitted by at least one selected from the group consisting of SECS protocol, GEM protocol, and HSMS protocol.

8. The device as stated in claim 6 or claim 7, wherein the parameter data are transmitted via serial cable that is connected between the semiconductor processing equipment and said device.

9. The device as stated in claim 6 or claim 7, wherein the parameter data are transmitted via at least one selected from the group consisting of either wired/wireless LAN or wired/wireless Internet whereby the semiconductor processing equipment and said device are coupled to the group.

10. The device as stated in claim 1, wherein said means for determining whether or not the wafer-positioning failure occurs by comparing the heater's lowest temperature and a predetermined threshold value comprises:

a flag indicating true and false for storing the occurrence of the wafer-positioning failure;

means for comparing the heater's lowest temperature with the threshold value in order to change an initialized value of said flag into true when the heater's lowest

temperature is smaller than the threshold value; and

means for detecting the value of said flag in order to determine wafer-positioning failure.

11. The device as stated in claim 1 further comprising means for comparing each of the heater's temperatures, which are received for a specific time that is predetermined according to characteristics of the semiconductor processing equipment, in order to determine whether or not wafer has been inserted.

12. The device as stated in claim 1, wherein the predetermined instruction is at least one selected from the group consisting of an instruction for outputting wafer-positioning failure signal, an instruction for suspending the process of the semiconductor processing equipment when wafer-positioning failure occurs, an instruction for adjusting wafer-positioning failure, and an instruction for adjusting the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs.

13. The device as stated in claim 1 or claim 12, wherein said means for managing the wafer-positioning failure that has occurred according to predetermined instruction comprises:

means for producing an adjusting control signal to adjust the position of wafer or the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs; and

means for outputting a positioning failure signal.

14. The device as stated in claim 13, wherein said means for outputting a positioning failure signal can be at least one selected from the group consisting of means for displaying, means for producing sound, and means for transmitting SMS or voice message, wherein said means for displaying comprises CRT and TFT and said means for producing sound comprises a buzzer.

15. A method for detecting wafer-positioning failure in semiconductor processing equipment having at least one chamber, wherein the wafer is located on a heater of the chamber, said method comprising the steps of:

receiving the heater's temperature from the semiconductor processing equipment;

extracting the heater's lowest temperature from a plurality of the heater's temperatures, which are received for a specific time that is predetermined according to characteristics of the semiconductor processing equipment;

determining whether or not the wafer-positioning failure occurs by comparing

the heater's lowest temperature and a predetermined threshold value; and

managing the wafer-positioning failure that has occurred according to predetermined instruction.

16. The method as stated in claim 15 further comprising inputting a threshold value, wherein the threshold value is extracted from a plurality of the heater's temperatures that are measured while the wafer-positioning failure does not occur.

17. The method as stated in claim 15 or claim 16, wherein the threshold value is an average of the heater's lowest temperatures that are measured while the wafer-positioning failure does not occur.

18. The method as stated in claim 15, wherein the heater's temperature is transmitted by at least one selected from the group consisting of SECS[SEMI(SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL) EQUIPMENT COMMUNICATION STANDARD] protocol, GEM protocol, and HSMS protocol.

19. The method as stated in claim 15, wherein said step of receiving the heater's temperature from the semiconductor processing equipment comprises the steps of:

receiving parameter data, wherein parameter data are related to the operating state and the process condition of the semiconductor processing equipment; and

extracting the heater's temperature from the received parameter data.

20 The method as stated in claim 19, wherein the parameter data are transmitted by at least one selected from the group consisting of SECS protocol, GEM protocol, and HSMS protocol.

21. The method as stated in claim 15, wherein said step of determining whether or not the wafer-positioning failure occurs by comparing the heater's lowest temperature and a predetermined threshold value comprises:

storing false in a flag for indicating the occurrence of the wafer-positioning failure;

comparing the heater's lowest temperature with the threshold value in order to change initialized value of said flag into true when the heater's lowest temperature is smaller than the threshold value; and

detecting the value of the flag in order to determine wafer-positioning failure.

22. The method as stated in claim 15 further comprising the step of comparing each of heater's temperatures, which are received for a specific time that is

predetermined according to characteristics of the semiconductor processing equipment, in order to determine whether or not wafer has been inserted.

23. The method as stated in claim 15, wherein the predetermined instruction is at least one selected from the group consisting of an instruction for outputting wafer-positioning failure signal, an instruction for suspending the process of the semiconductor processing equipment when wafer-positioning failure occurs, an instruction for adjusting wafer-positioning failure, and an instruction for adjusting the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs.

24. The method as stated in claim 15 or claim 23, wherein said step of managing the wafer-positioning failure that has occurred according to predetermined instruction comprises:

producing an adjusting control signal to adjust the position of wafer or the transferring device of the semiconductor processing equipment when wafer-positioning failure occurs; and

outputting a positioning failure signal.

FIG. 1A

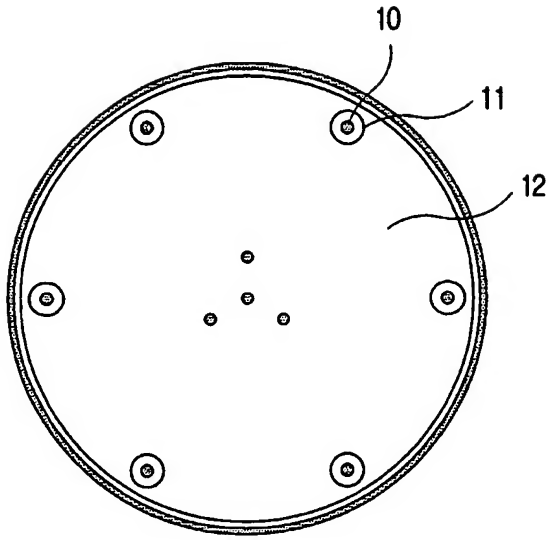


FIG. 1B

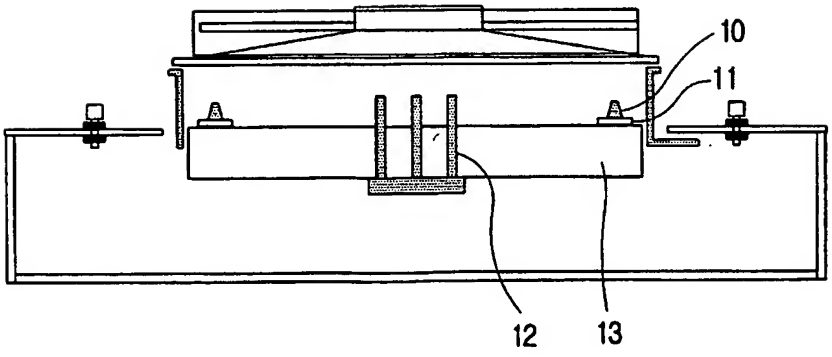


FIG. 2A

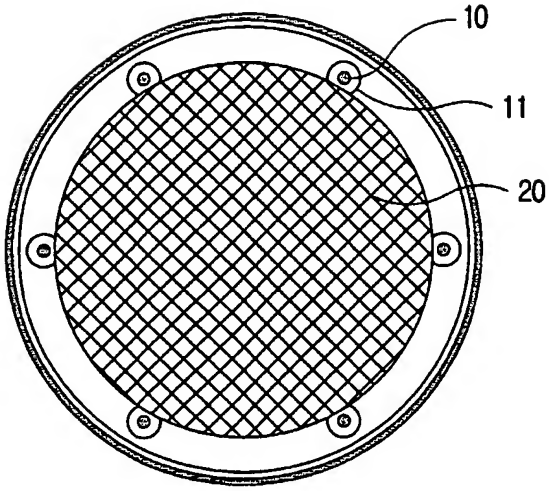


FIG. 2B

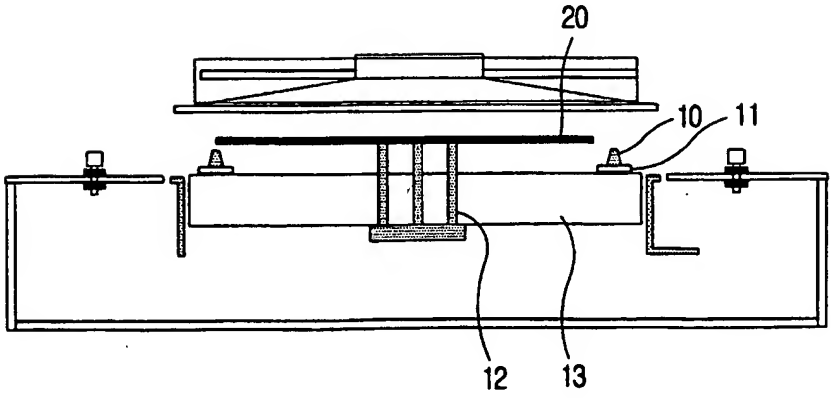


FIG. 3A

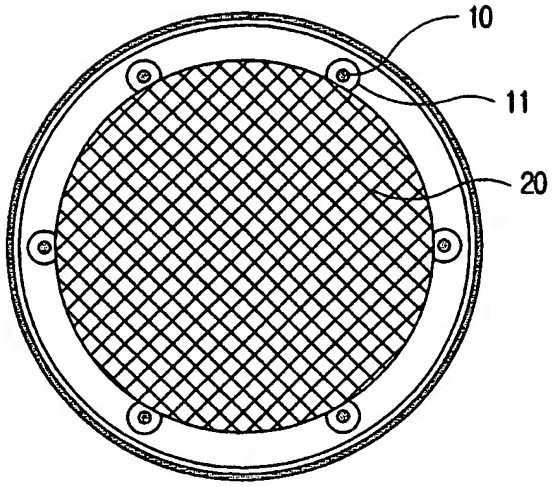


FIG. 3B

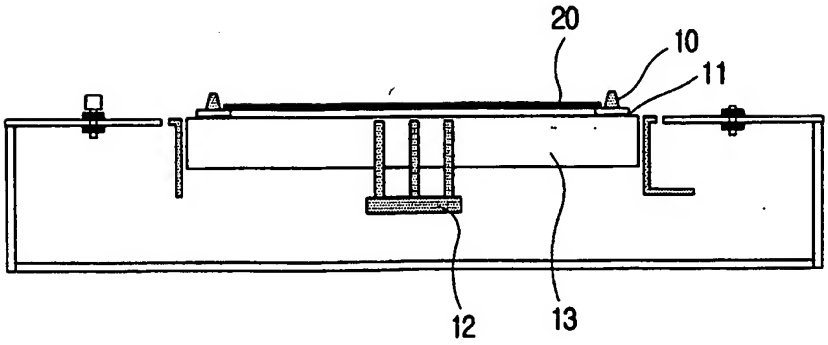


FIG. 4A

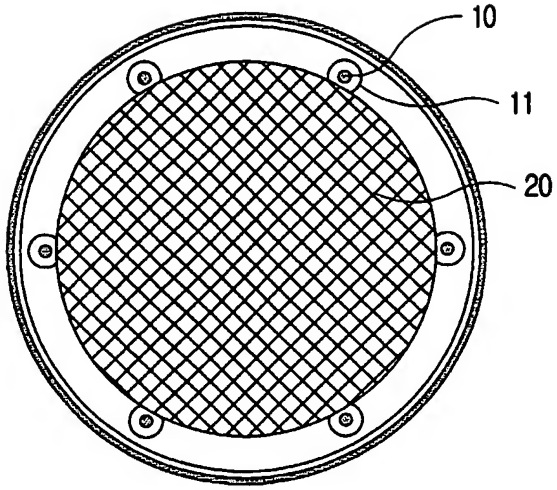
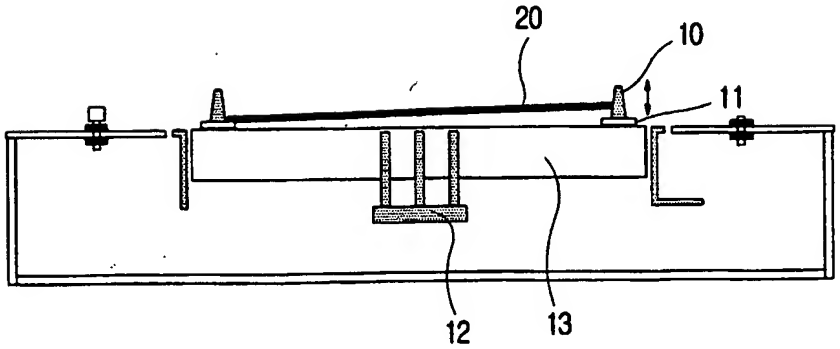


FIG. 4B



5/9

FIG. 5

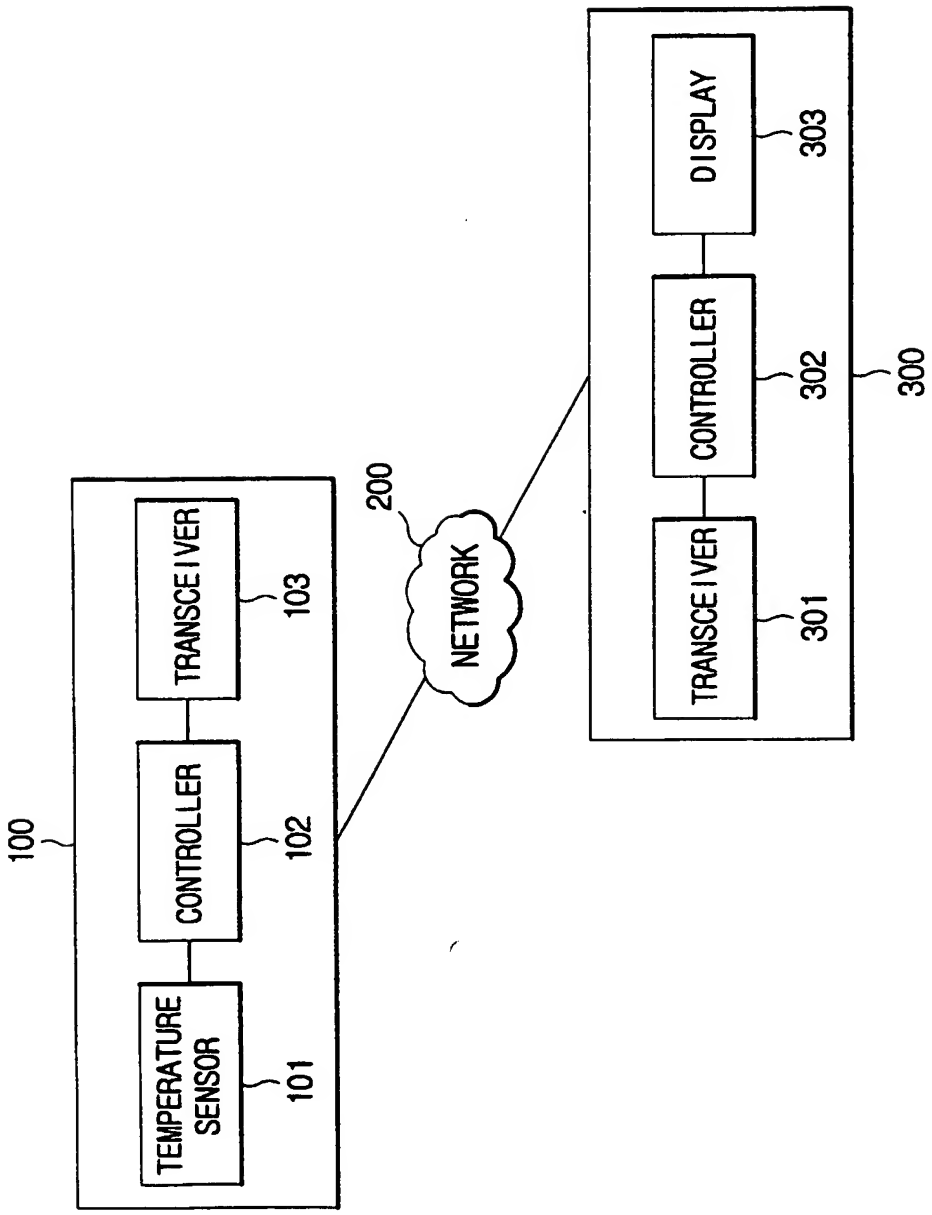

100
TEMPERATURE SENSOR
101
CONTROLLER
102
TRANSCEIVER
103
200
NETWORK
300
TRANSCEIVER
301
CONTROLLER
302
DISPLAY
303

FIG. 6

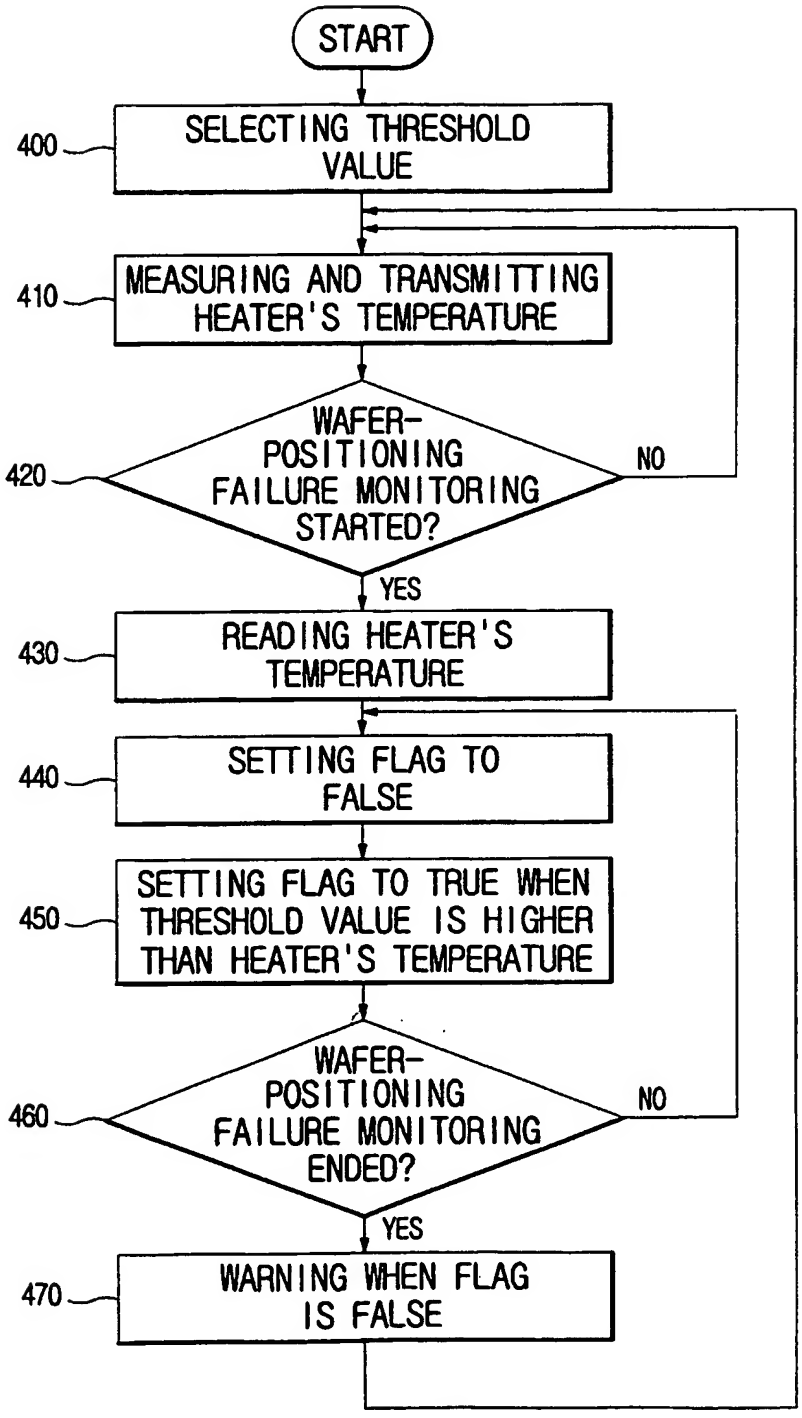
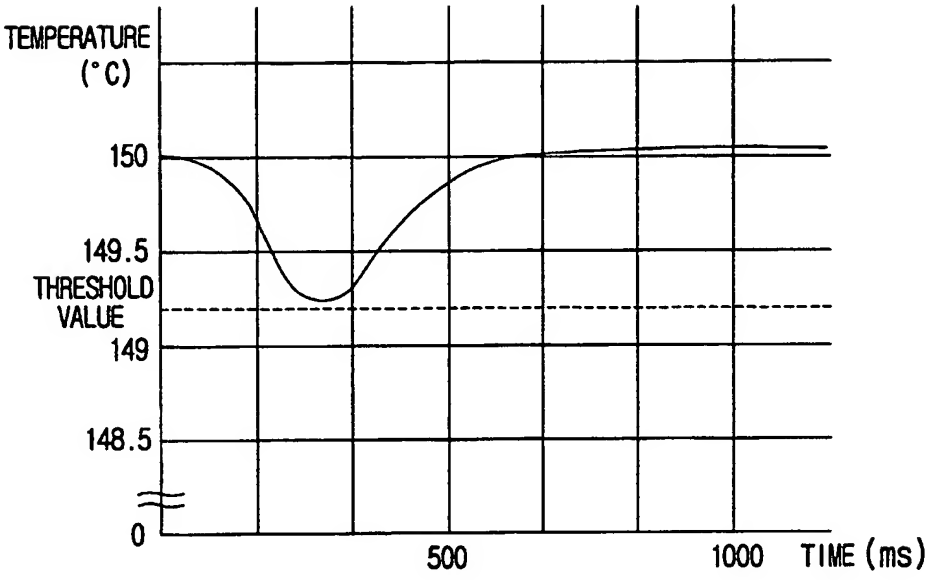

START
400
SELECTING THRESHOLD VALUE
410
MEASURING AND TRANSMITTING HEATER'S TEMPERATURE
420
WAFER-POSITIONING FAILURE MONITORING STARTED?
NO
YES
430
READING HEATER'S TEMPERATURE
440
SETTING FLAG TO FALSE
450
SETTING FLAG TO TRUE WHEN THRESHOLD VALUE IS HIGHER THAN HEATER'S TEMPERATURE
460
WAFER-POSITIONING FAILURE MONITORING ENDED?
NO
YES
470
WARNING WHEN FLAG IS FALSE

FIG. 7A


TEMPERATURE
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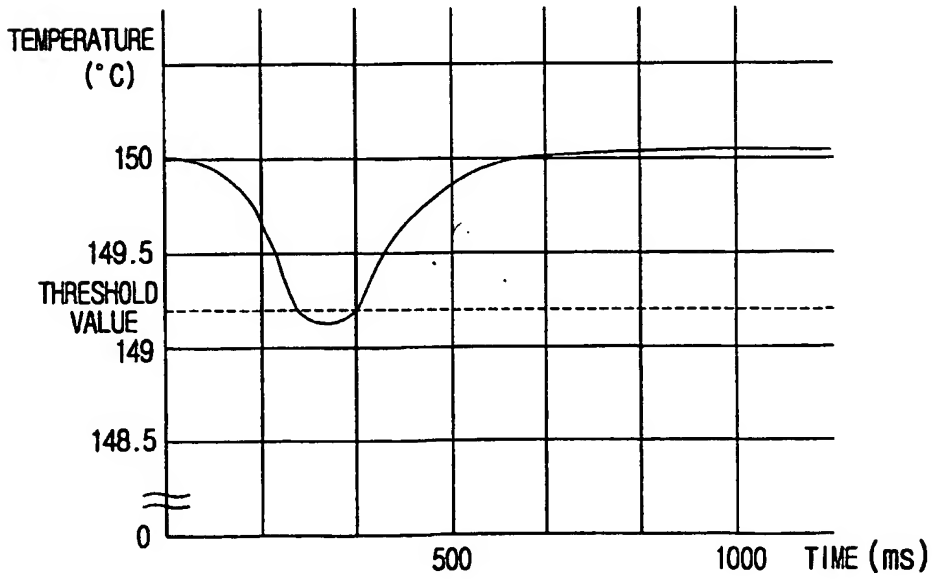
150
149.5
THRESHOLD
VALUE
149
148.5
0
500
1000
TIME (ms)

FIG. 7B


TEMPERATURE
(°C)
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149.5
THRESHOLD
VALUE
149
148.5
0
500
1000
TIME (ms)

FIG. 8A

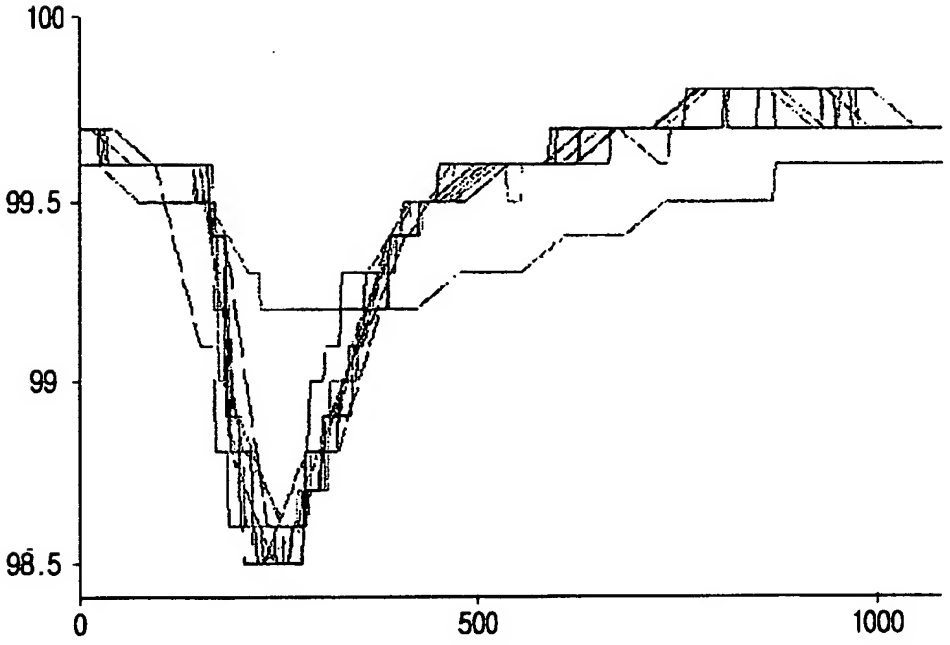


FIG. 8B

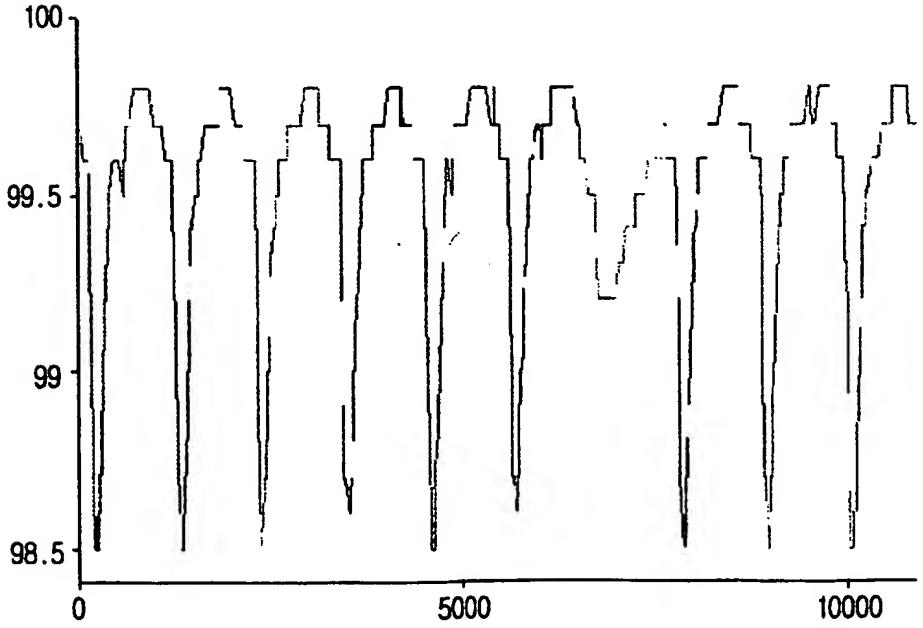


FIG. 9A

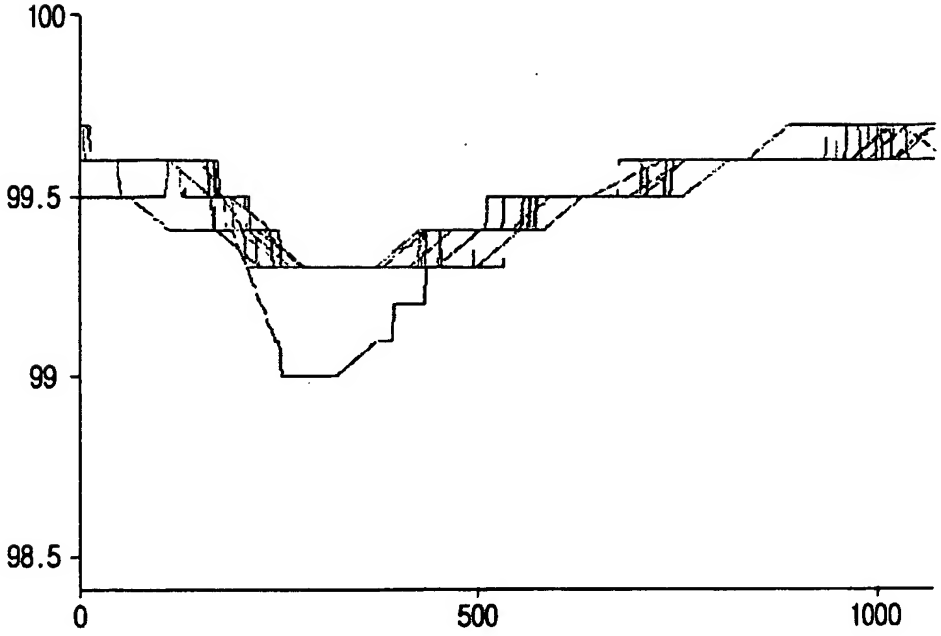
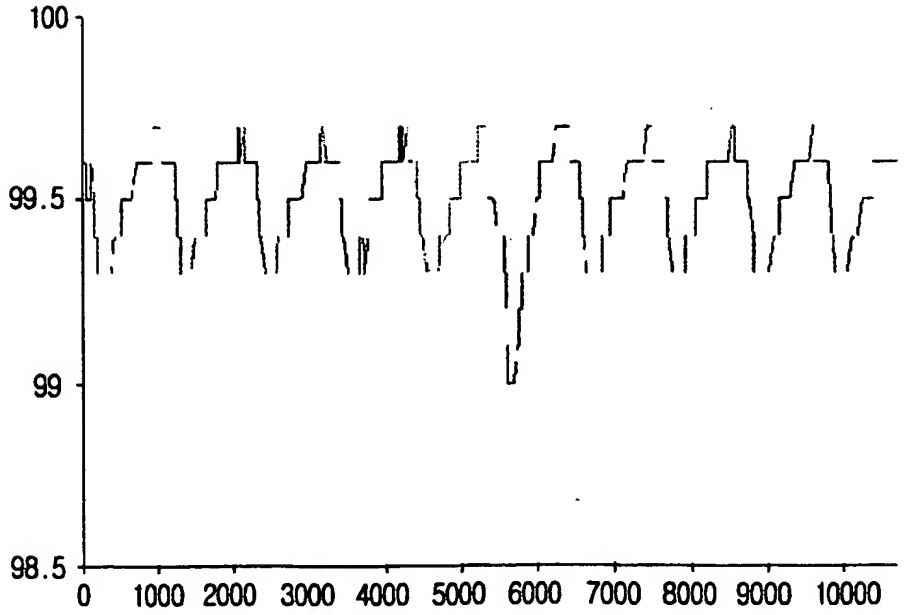

100
99.5
99
98.5
0
500
1000

FIG. 9B


100
99.5
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1000
2000
3000
4000
5000
6000
7000
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9000
10000

INTERNATIONAL SEARCH REPORT

national application No.
PCT/KR02/00285

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H01L 21/68, H01L 21/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean patents and applications for inventions since 1975, Korean utility models and applications for utility models since 1975
Japanese patents and applications for inventions since 1976

Electronic data base consulted during the internationl search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 01-019723 A (NEC KANSAI LTD) 23 JANUARY 1989 see the whole document	1, 15
A	JP 62-273745 A (MITSUBISHI ELECTRIC CORP) 27 NOVEMBER 1987 see figure 1 and 2	1, 15
A	JP 61-270840 A (TAKAOKA KOICHIRO) 1 DECEMBER 1986 see the whole document	1, 15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevence
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 APRIL 2002 (08.04.2002)	09 APRIL 2002 (09.04.2002)

Name and mailing address of the ISA/KR	Authorized officer
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Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5721

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR02/00285

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 01-019723 A	23 JANUARY 1989	NONE	
JP 62-273745 A	27 NOVEMBER 1987	NONE	
JP 61-270840 A	1 DECEMBER 1986	NONE	